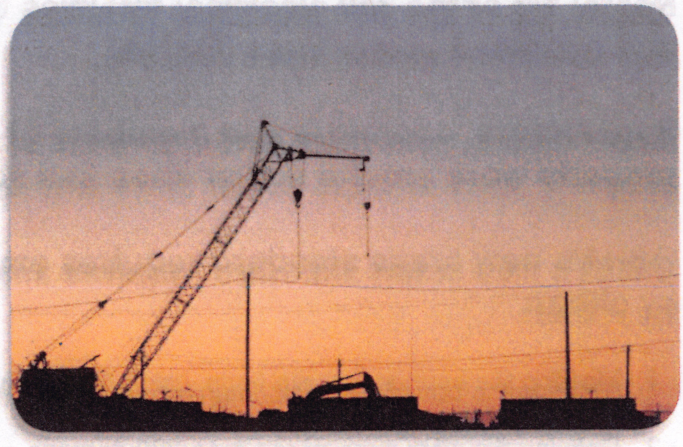
Module 27
Operations Around Electricity



Learning Objectives

By the end of this section, you will:

1. Know the two options employers have to mark the work zone near a power line under the new OSHA standard.
2. Know the three options employers have to safely work around energized power lines.
3. Understand the need to identify the minimum clearance distances from power lines for crane operation, using Table A in the OSHA standard.
4. Know safeguards needed to work within the restricted zone.
5. Know how to exit a crane that has struck a power line.
6. Know the training requirements under 1926.1408.

Case Study

On October 12, 2004, a 26-year-old Hispanic laborer (the victim) was electrocuted at a materials storage yard, as he guided an auger being lifted by a truck-mounted crane onto a truck. A 7,200 volt overhead power line ran through the middle of the 5-acre materials storage yard. The victim was holding on to the auger when the boom moved, apparently causing the crane boom or load line to contact the power line, and the electricity to flow through the victim's body. Two workers employed by another subcontractor that were assisting the victim were also shocked and knocked to the ground by the electric current. They were not permanently injured. The crane operator saw that the three employees had fallen to the ground. He came down from the crane operating position and ran to check on the men and look at the crane boom, the load line, and the power lines. [Since the crane operator was not shocked, it is assumed that he moved the boom away from the power lines before exiting the crane cab.] He then ran back to the operating position, lowered the auger to the ground, and then returned to the men. Finding that the victim had no apparent pulse and did not appear to be breathing, the crane operator began cardiopulmonary (CPR) resuscitation efforts. One of the workers who had been shocked ran to a nearby building to call 911, while the other waited for Emergency Medical Services (EMS). EMS personnel responded within approximately 20 minutes and continued CPR on the victim. The victim remained unresponsive and was transported by ambulance to a nearby hospital, where he was pronounced dead by an emergency room physician. The two injured workers were transported to another hospital in the area and examined. One of them was released that day, and the other was admitted to the hospital and released two days later.

Nearly 1/3 of the 350 electrical fatalities that occur annually involve cranes and overhead power lines (OSHA).

Supervisors, operators and members of ground crew must know how to properly work around power lines and equipment.

OSHA's new crane standard requires employers to identify the work zone by either:

OSHA
1926.1408(a)(1)

1. Marking the boundaries with flags, using range limiting devices or range control warning devices, or
2. Defining the work zone as the area 360 degrees around the equipment, up to the equipment's maximum working radius.

If any part of the equipment, line or load at maximum working radius could get within 20 ft., the employer must act!

OSHA gives the employer 3 options:

- **Option 1: De-energize and ground**
- **Option 2: Maintain 20-foot clearance**
- **Option 3: Use minimum approach distance from Table A**

LANGUAGE FROM THE STANDARD:

OSHA
1926.1408(a)(2)(i)
1926.1408(a)(2)(ii)
1926.1408(a)(2)(iii)(A)
1926.1408(a)(2)(iii)(B)

Option (1)--De-energize and ground.
Confirm from the utility owner/operator that the power line has been de-energized and visibly grounded at the work site. ASME in its B30.5-2011 standard say: "Any overhead wire shall be considered to be an energized line unless and until the person owning such line or the electrical utility authorities indicate that it is not an energized line. Crane operators and other personnel directly involved with the lifting operations shall not rely on the coverings of wires for protection."

Option (2)--20 foot clearance.
Ensure that no part of the equipment, load line, or load (including rigging and lifting accessories), gets closer than 20 feet to the power line by implementing the measures specified in paragraph (b) of this section.

Option (3)--Table A clearance.

- Determine the line's voltage and the minimum approach distance permitted under Table A (see § 1926.1408).
- Determine if any part of the equipment, load line or load (including rigging and lifting accessories), while operating up to the equipment's maximum working radius in the work zone, could get closer than the minimum approach distance of the power line permitted under Table A (see § 1926.1408).

If so, then the employer must follow the requirements in paragraph (b) of this section to ensure that no part of the equipment, load line, or load (including rigging and lifting accessories), gets closer to the line than the minimum approach distance.

How does a crane operator know a line is de-energized?

OSHA 1926.1408(a)(2)(i)

» The utility owner/operator must confirm that the power line has been and continues to be de-energized and visibly grounded at the work site.

If there is a chance of getting within 20 feet (encroachment) the employer must:

- Conduct a planning meeting with the operator and crew to review the location of the power lines and the steps that will be implemented to prevent encroachment/electrocution.
- Use non-conductive tag lines, if needed.
- Erect and maintain an elevated warning line, barricade, or line of signs, in view of the operator, equipped with flags or similar high-visibility markings, at 20 feet from the power line (or minimum approach distance under Table A).

What must happen if the operator can't see the elevated warning lines?

OSHA 1926.1408(b)(3)

» The employer must provide a dedicated spotter.

If hand signals are to be used, the job supervisor, the operator and the spotter should meet to review the signals.

Radio communication during operation is highly recommended. It is more accurate, takes less time and does not require operator to take sight off of load or lines.

What minimum distance is needed for a 700 kV power line? Is this AC or DC?

» 35 feet. AC.

What distance for 350 kV?

» 20 feet.

TABLE A—MINIMUM CLEARANCE DISTANCES

Voltage (nominal, kV, alternating current)	Minimum clearance distance (feet)
up to 50	10
over 50 to 200	15
over 200 to 350	20
over 350 to 500	25
over 500 to 750	35
over 750 to 1,000	45
over 1,000	(as established by the utility owner/operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution).

Note: The value that follows "to" is up to and includes that value. For example, over 50 to 200 means up to and including 200kV.

How does the person responsible for setting up the job know the voltage of power lines to establish the required distance?

» The power company must be contacted and has 2 business days to return the voltage information.

Insulated lines can conduct electricity through tiny cuts or cracks.

Power company representatives can supply reliable safety information and can offer valuable advice about setting up a job.

Power company representatives may be able to arrange for and provide alternatives to work around live power lines.

In some cases, the power company can de-energize power lines for specified periods of time.

When power lines are de-energized, the power company will open the breaker or switches and visibly ground the line. Even when the power company has de-energized and visibly grounded a power line, the line must always be treated as energized.

De-energizing a line can not be a last minute detail!

Supervisors should contact power company well in advance of time required. A job should not proceed until safety compliance is established.

Safe operation around power lines begins with pre-job planning. What would you consider?

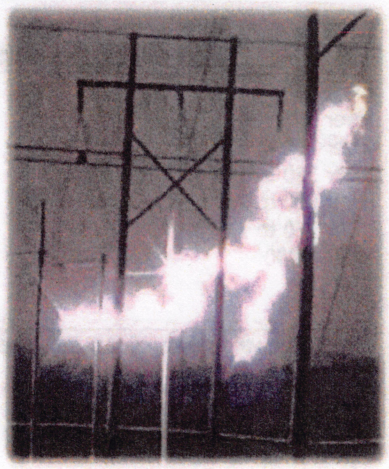
» Safeguards against tipping or structural failure that could cause crane to fall into power lines.

» Wind speed to avoid a load blowing into the danger zone.

» Wind direction while swinging the load.

Arcing occurs when electricity is discharged from one surface to another.

Given high voltage and right atmospheric conditions, airspace between the power line and crane boom can act as a surface that will conduct electricity.



Factors increase the possibility of arcing:

- Moisture content in air.
- Moisture content in soil.
- Boom material (type of metal).
- Surface area of boom (particularly hydraulic booms).

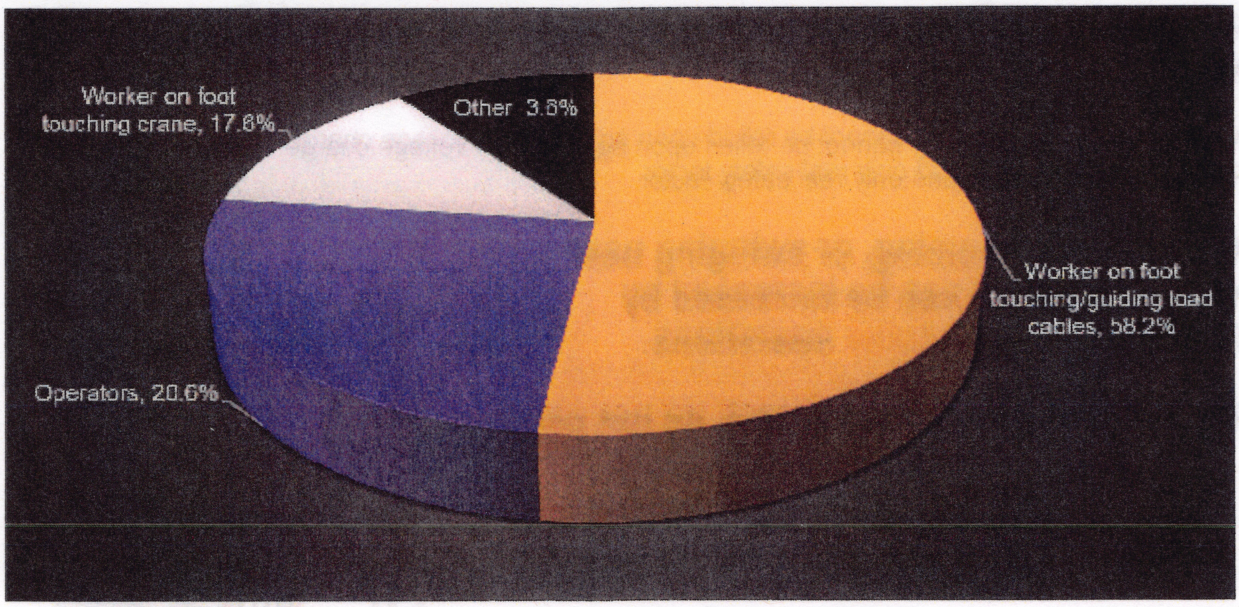
Unless the line has been de-energized and visibly grounded the operator must not move any part of the crane or the crane's load within the danger zone.

"Single shot" protection on breakers protects power company equipment NOT the crane, operator or ground crew.

If the power line is equipped with a device that automatically reenergizes the circuit in the event of a power line contact, before the work begins, the automatic reclosing feature of the circuit interrupting device must be made inoperative if the design of the device permits.

This is an expensive and timely operation and must be planned well in advance. Although limited in coverage areas and expensive, installing guard structures is effective when working in confined area near power lines.

Who died from overhead power line electrocutions?



(252 deaths from 2008 - 2010, CPWR)

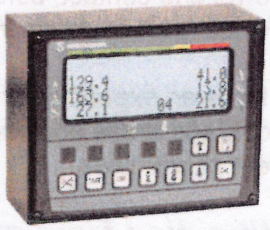
Electrocution from overhead power lines remains the leading cause of electrocution deaths, accounting for nearly 1/2 of the overall electrocution fatalities according to the CPWR.

When near power lines, ground personnel should avoid touching the load or the line.

Tag lines should be used to prevent load from swinging into power lines.

- Tag lines should be used to prevent load from swinging into power lines.
- Synthetic web slings can be used to control or attach loads.
- Wire rope and damp ropes should NEVER be used as tag lines.
- Ropes with superior insulation should be used, such as clear, dry polypropylene, polyester or polyethylene.

OSHA allows alternative devices, but they can't be a sole means of protection.



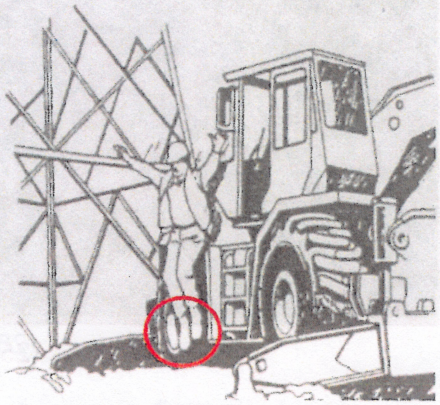
- Cage-type boom guards.
- Insulating links.
- Isolation or proximity warning devices.

Minimum operating distances must still be maintained!

Ground rods may help in grounding the crane and are required in some areas.

Grounding rods or rubber tires cannot be relied upon against high voltage charge. Danger zone is the absolute limit of approach and only real safety factor.

When hoisting, booming, or swinging near power lines, safety can be increased by conducting slow, cautious operations.

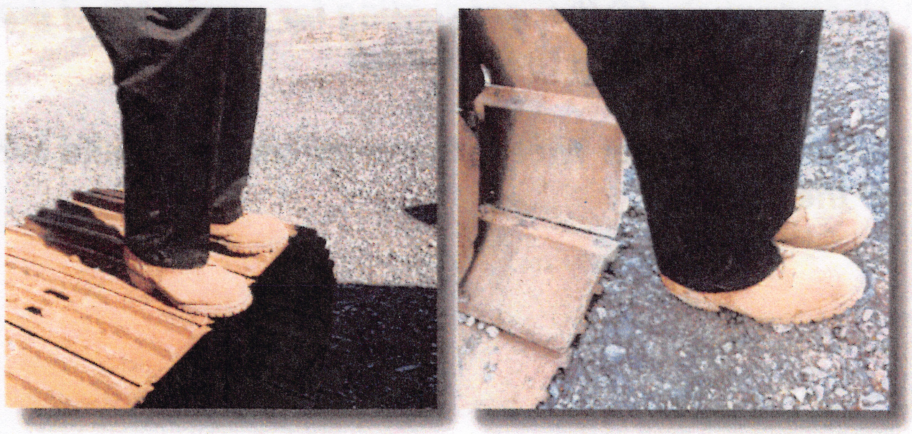


In the event of power line contact, do not panic.

- Remain in cab if possible.
- Slowly move crane away from the line.
- Warn everyone to stay back and not touch the crane.

Get away safely if you must exit.

- If you must get out, jump with your feet together (don't step down).
- Land upright with feet together.
- Do not touch the machine or outriggers.
- Hop or shuffle out of the area, the distance between normal steps can be enough to electrocute you.



When crane contacts a power line, the crane, the load, the surrounding area and objects in the surrounding area can become energized.

The Ground May Be Energized!

- Electricity decreases with the resistance of the ground.
- As potential drops, fields develop around the electrified machine.
- If you step across a line of unequal potential, you could be electrocuted.
- Underground pipes can carry energy over great distances due to high conductivity.

Ground crew should not attempt to approach the crane or handle any part of the rigging or load if crane contacts power lines.

They should evacuate the area in the same manner as the operator (hopping or shuffling).

The operator can not be solely relied upon to maintain proper distance due to visual perspective, obstructions, and demands of crane operation.

OSHA sets minimum clearances for cranes traveling with no load on a construction site.

Table T: In transit with no load and boom or mast lowered

Normal Voltage, kV (Phase to Phase)	Minimum Required Clearance (ft)
Up to 0.75	4
Over 0.75 to 50	6
Over 50 to 345	10
Over 345 to 750	16
Over 750 to 1,000	20
Over 1,000	As established by the utility owner/operator or registered P.E. who is a qualified person with respect to electrical power transmission and distribution.

During travel, if any part of the crane will get closer than 20 feet to the power line, a dedicated spotter is required.

- Must be in continuous contact with the operator.
- Must give timely information to the operator so that the required clearance distance can be maintained.

At night or in fog, OSHA requires that power lines be illuminated or another means of locating lines is used.

Once job is complete, operator must move crane away from power lines or secure the equipment to avoid accidental contact when left unattended.

Write down the topics that training must cover under section 1926.1408.

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1926.1408(g)

- The employer must train each operator and crew member assigned to work with the equipment.
- The procedures to be followed in the event of electrical contact with a power line.
- Information regarding the danger of electrocution from the operator simultaneously touching the equipment and the ground.
- The importance to the operator's safety of remaining inside the cab except where there is an imminent danger of fire, explosion, or other emergency that necessitates leaving the cab.
- The safest means of evacuating from equipment that may be energized.
- The danger of the potentially energized zone around the equipment (step potential).
- The need for crew in the area to avoid approaching or touching the equipment and the load.
- Safe clearance distance from power lines.
- Power lines are presumed to be energized unless the utility owner/operator confirms that the power line has been and continues to be de-energized and visibly grounded at the work site.
- Power lines are presumed to be uninsulated unless the utility owner/operator or a registered engineer who is a qualified person with respect to electrical power transmission and distribution confirms that a line is insulated.
- The limitations of an insulating link/device, proximity alarm, and range control (and similar) device, if used.
- The procedures to be followed to properly ground equipment and the limitations of grounding.
- Employees working as dedicated spotters must be trained to enable them to effectively perform their task, including training on the applicable requirements of this section.